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Manole

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(54) **ROTARY COMPRESSOR HAVING A DISCHARGE VALVE**

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F03C 2/00 (2006.01)
F04C 18/00 (2006.01)

(52) **U.S. Cl.** **418/173**; 418/177; 418/270; 417/356; 137/539; 137/540

(58) **Field of Classification Search** .... 418/172, 418/173, 177, 270, DIG. 1; 417/356, 902; 137/540, 539, 543.15, 543.17
See application file for complete search history.

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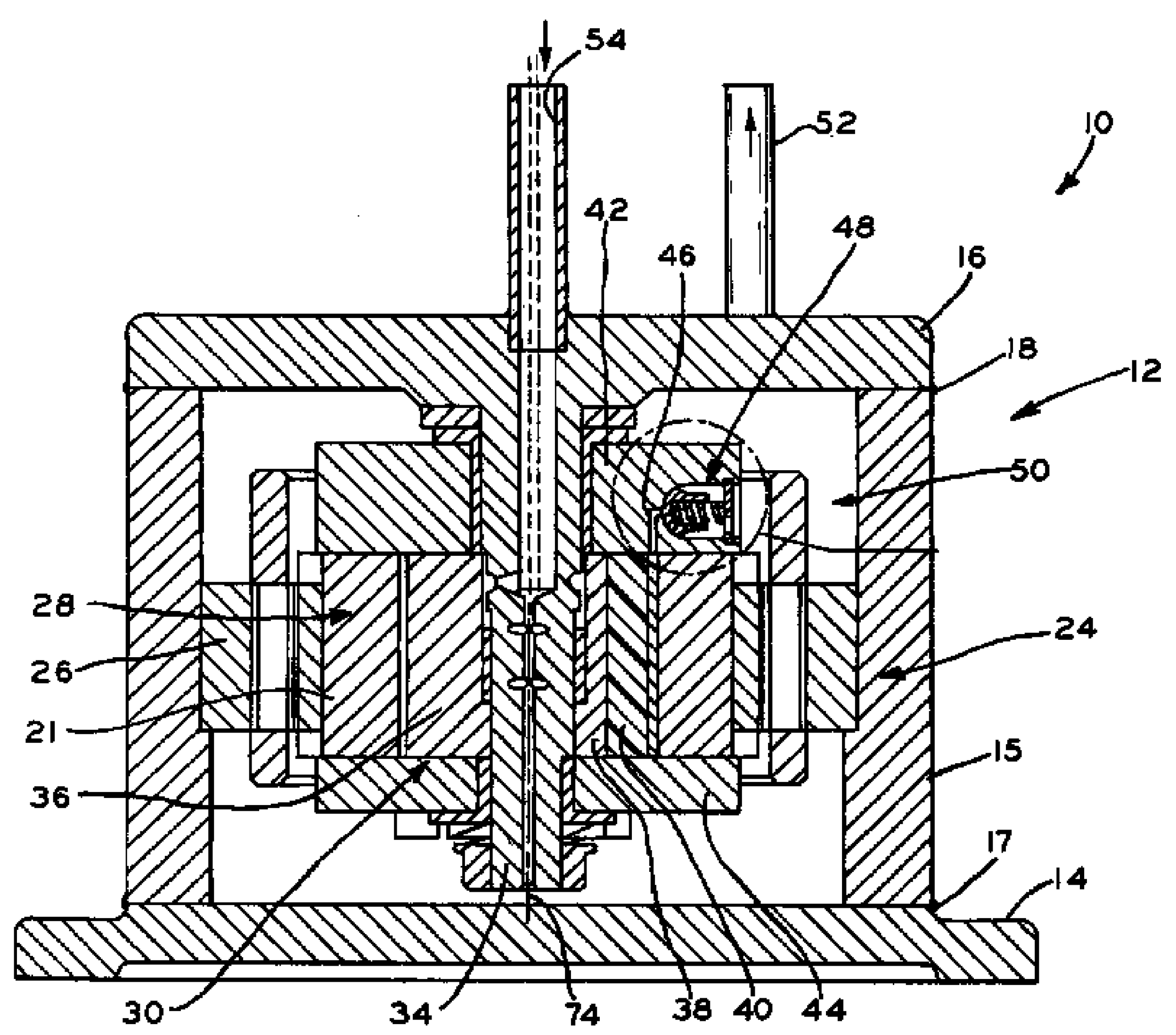
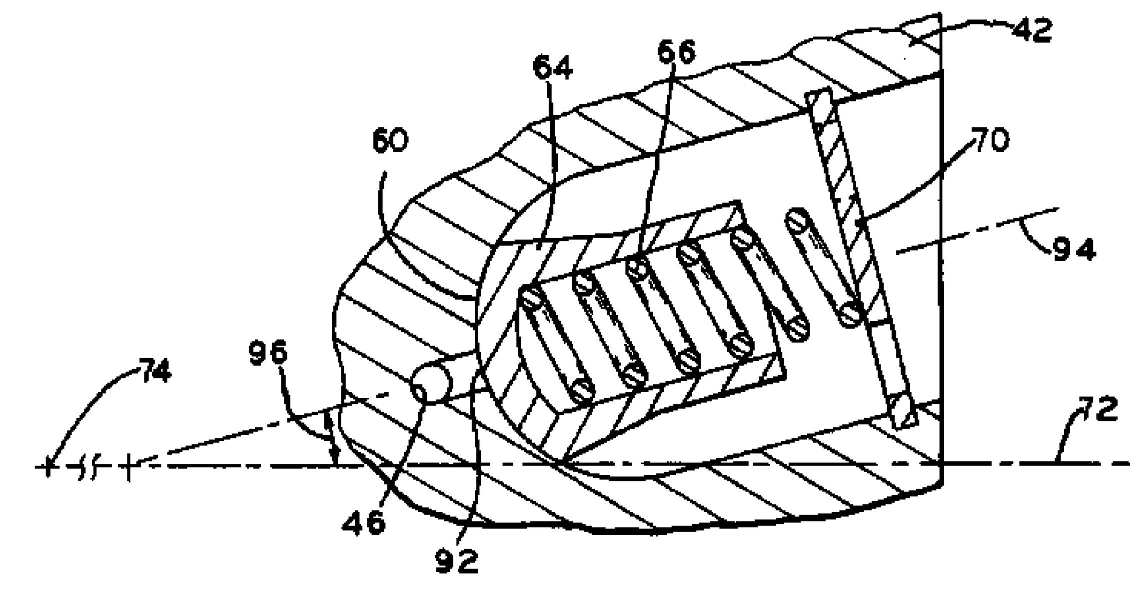
(57) **ABSTRACT**

A rotary compressor having a housing, a rotor positioned within the housing defining a compression chamber, the rotor rotatable about an axis of rotation, a discharge port in the rotor in fluid communication with the compression chamber, and a valve assembly mounted to the rotor to regulate the pressure of the fluid within the compression chamber. In one embodiment, the valve assembly is canted or obliquely aligned with respect to the axis of rotation of the rotor and a radial axis perpendicular to and intersecting the axis of rotation. Aligning the valve assembly in this way allows the displacement of the valve head of the valve assembly to be substantially collinear with forces acting on the valve head.

3 Claims, 9 Drawing Sheets





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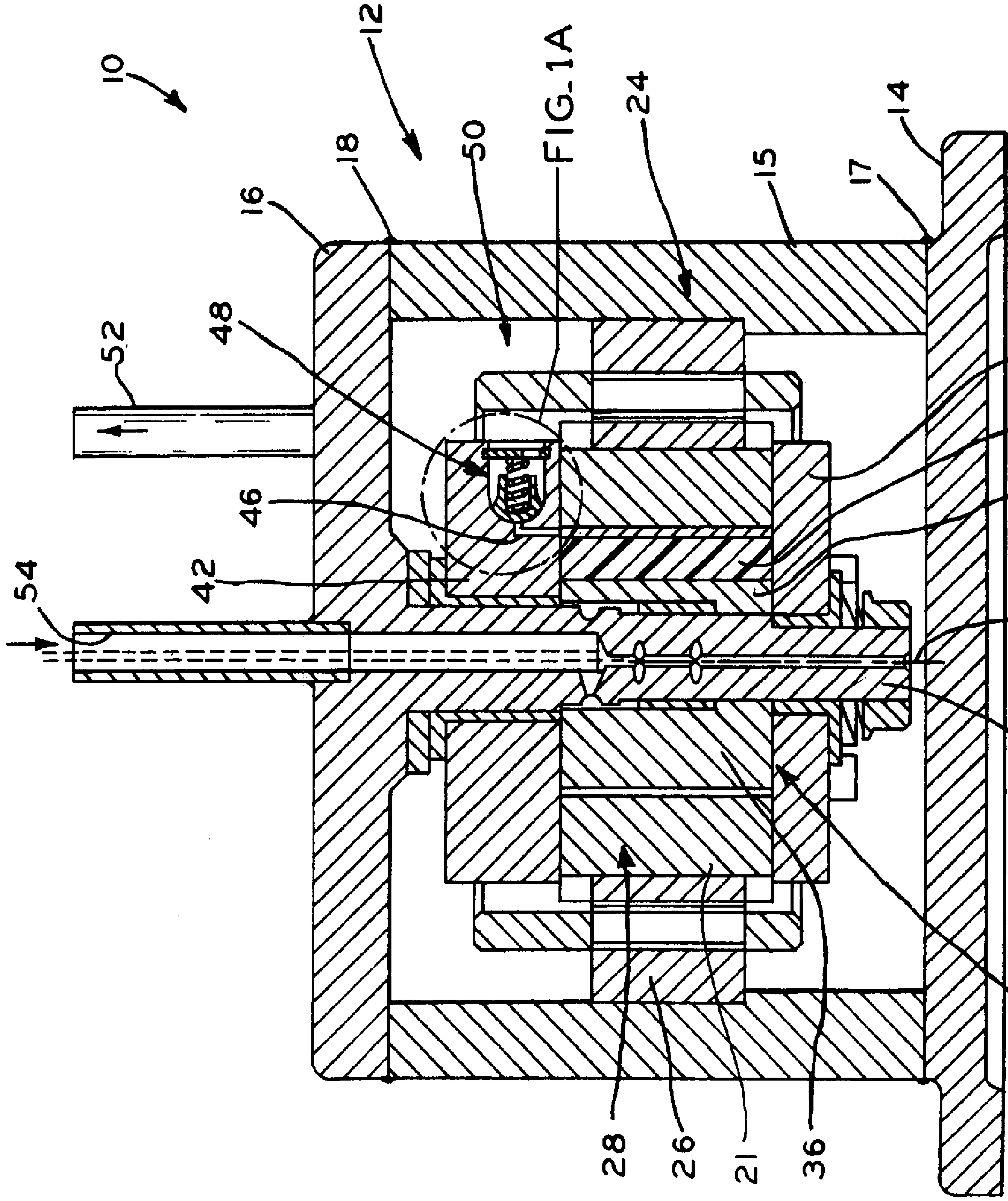
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FIG_1A

FIG_1

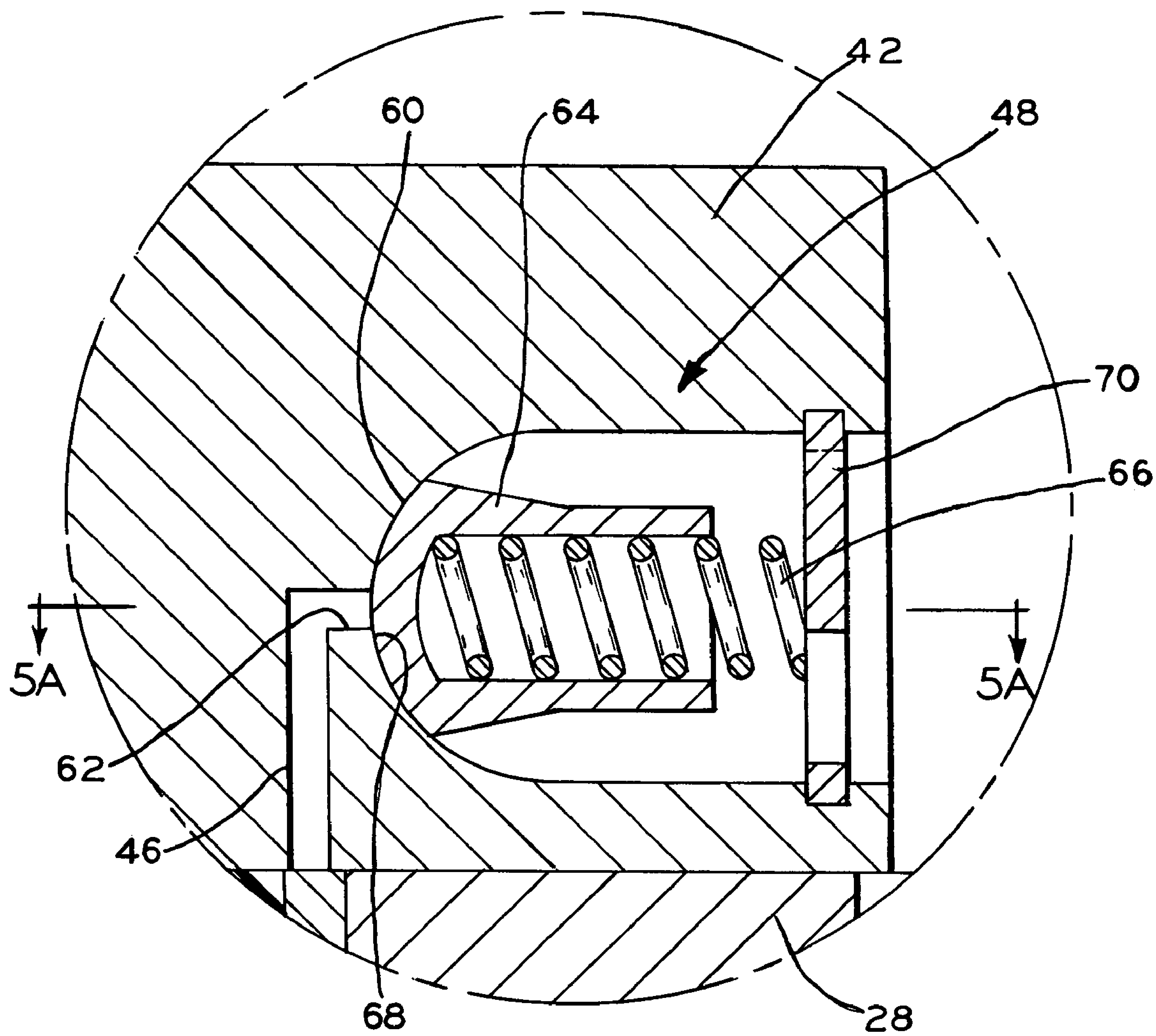

FIG. 1A

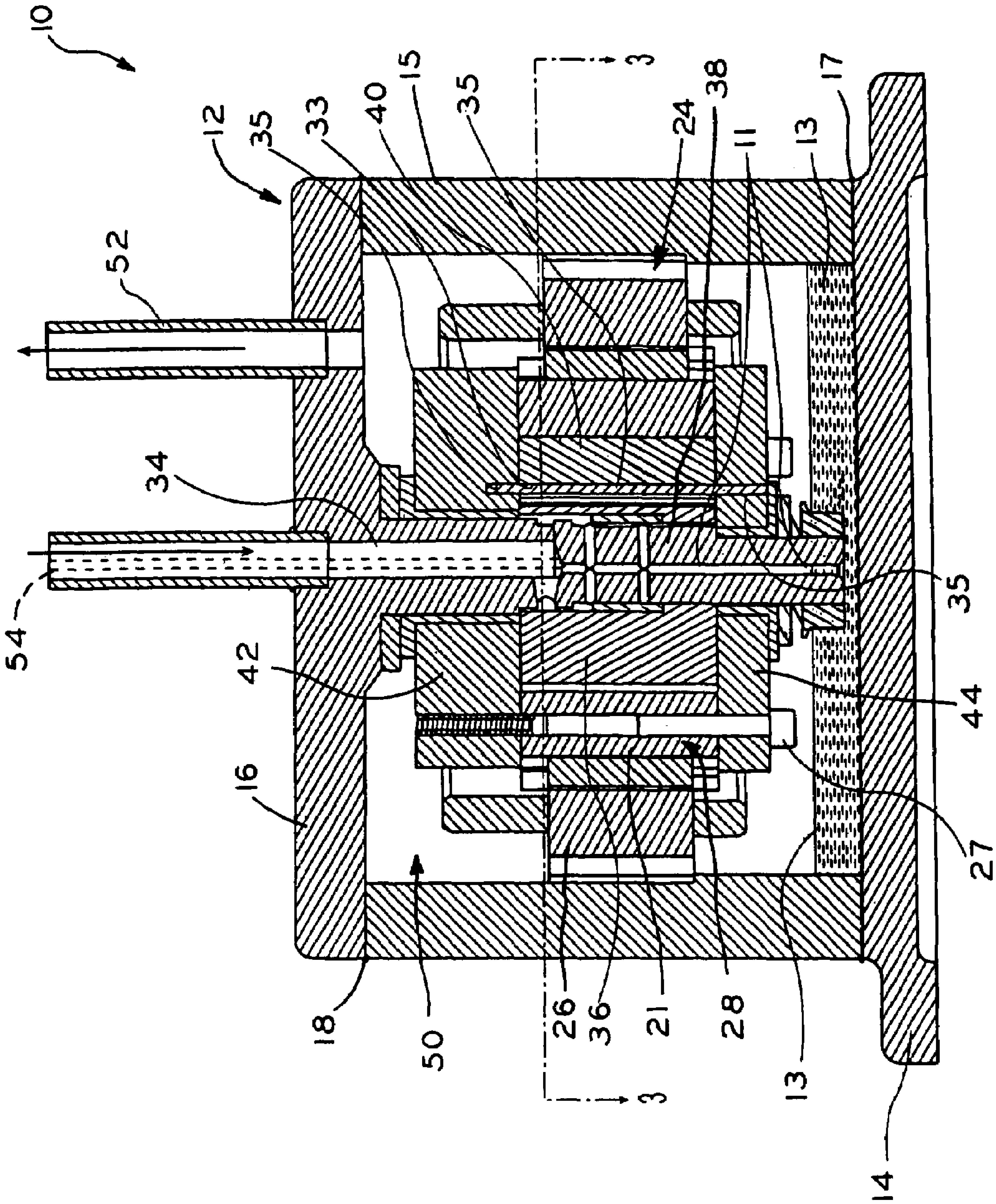
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FIG. 2

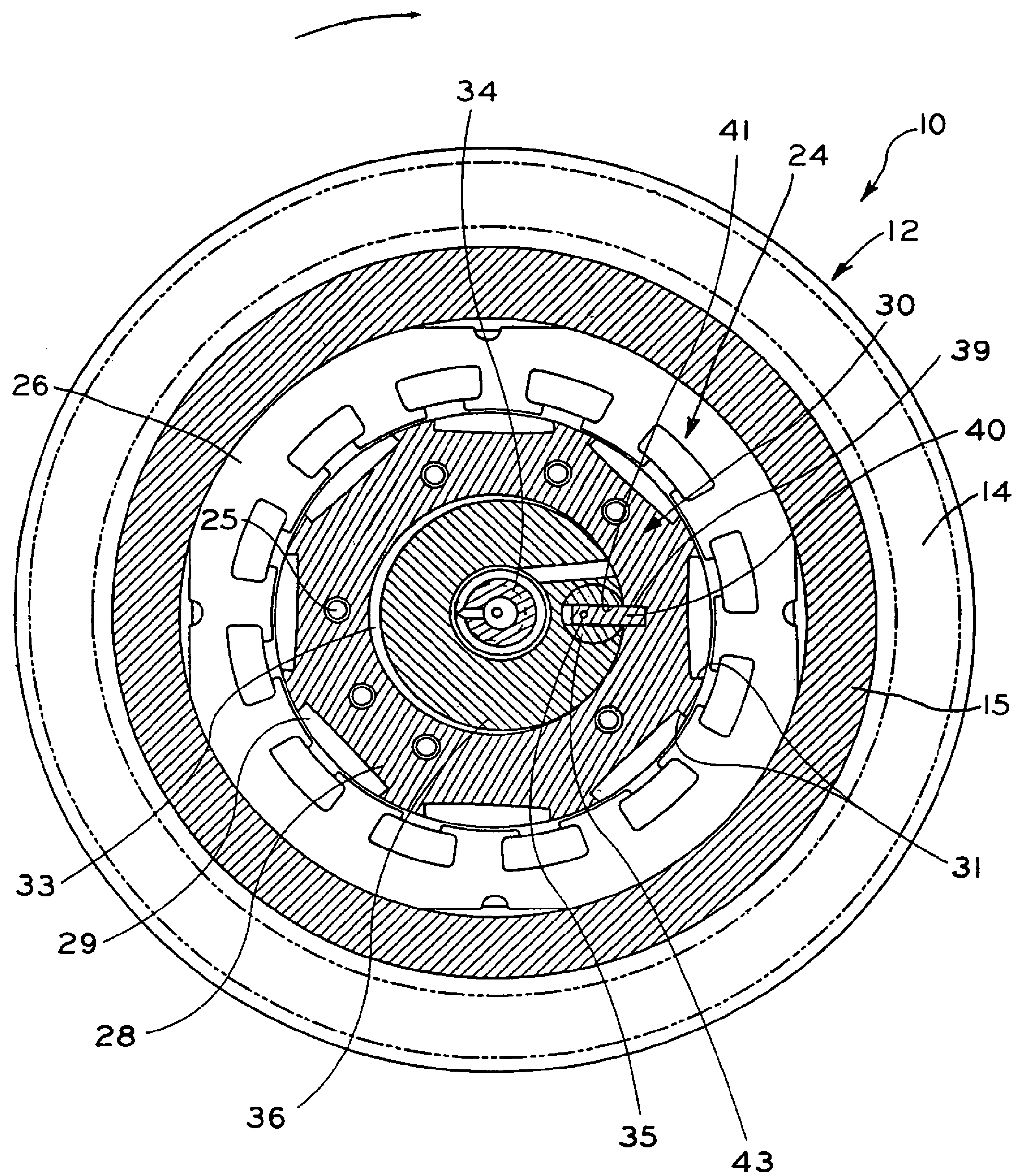

FIG. 3

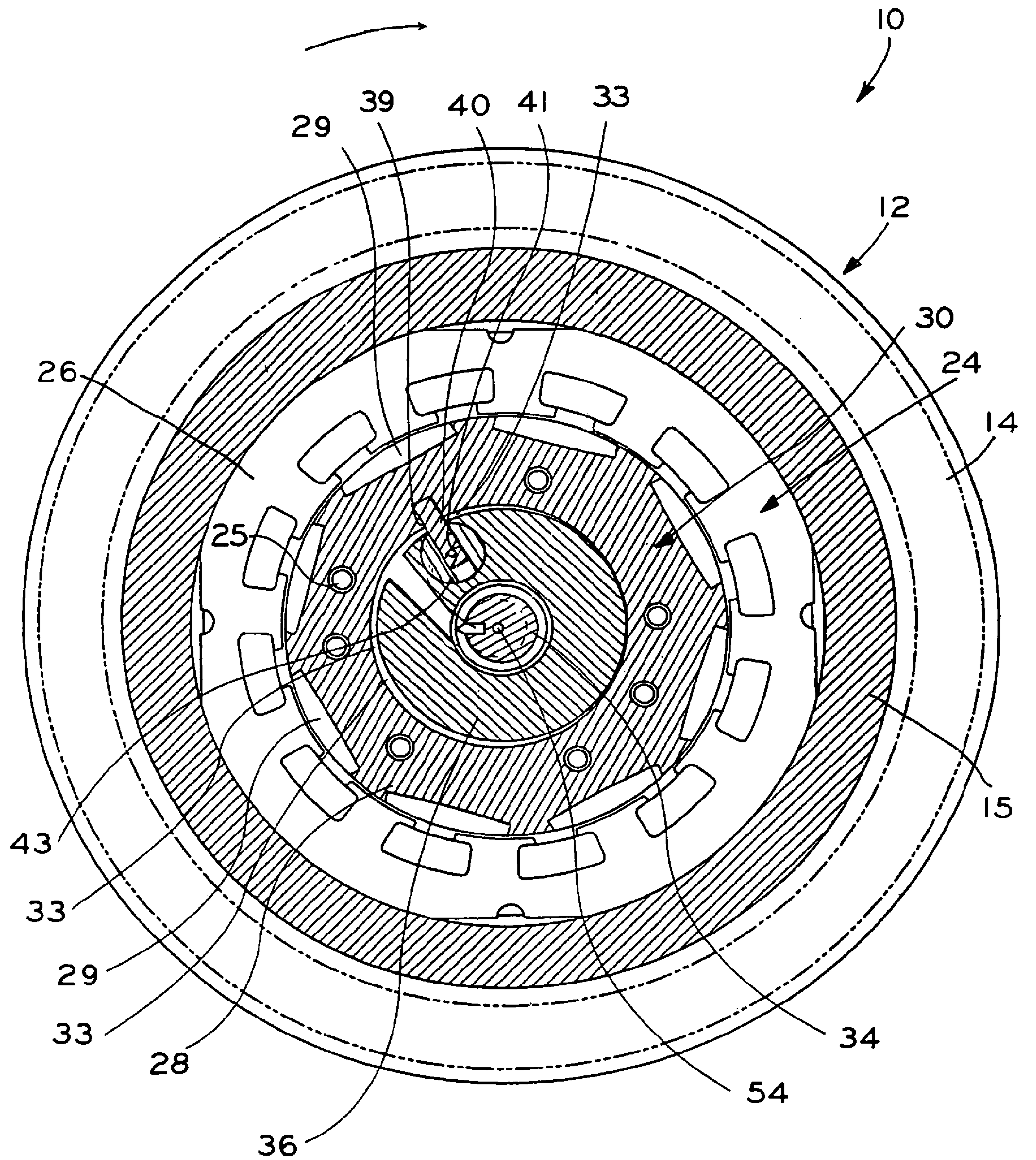

FIG. 4

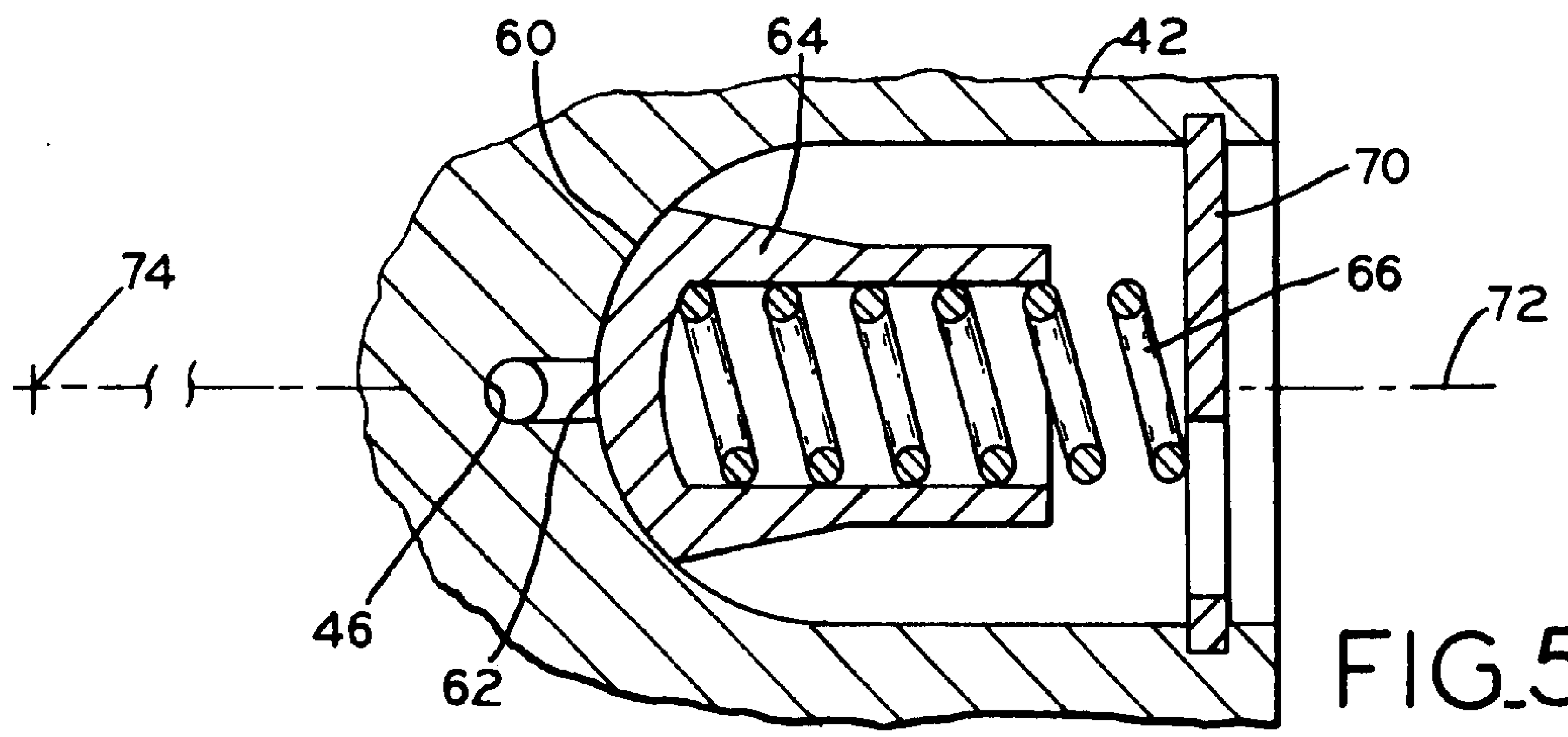

FIG.5A

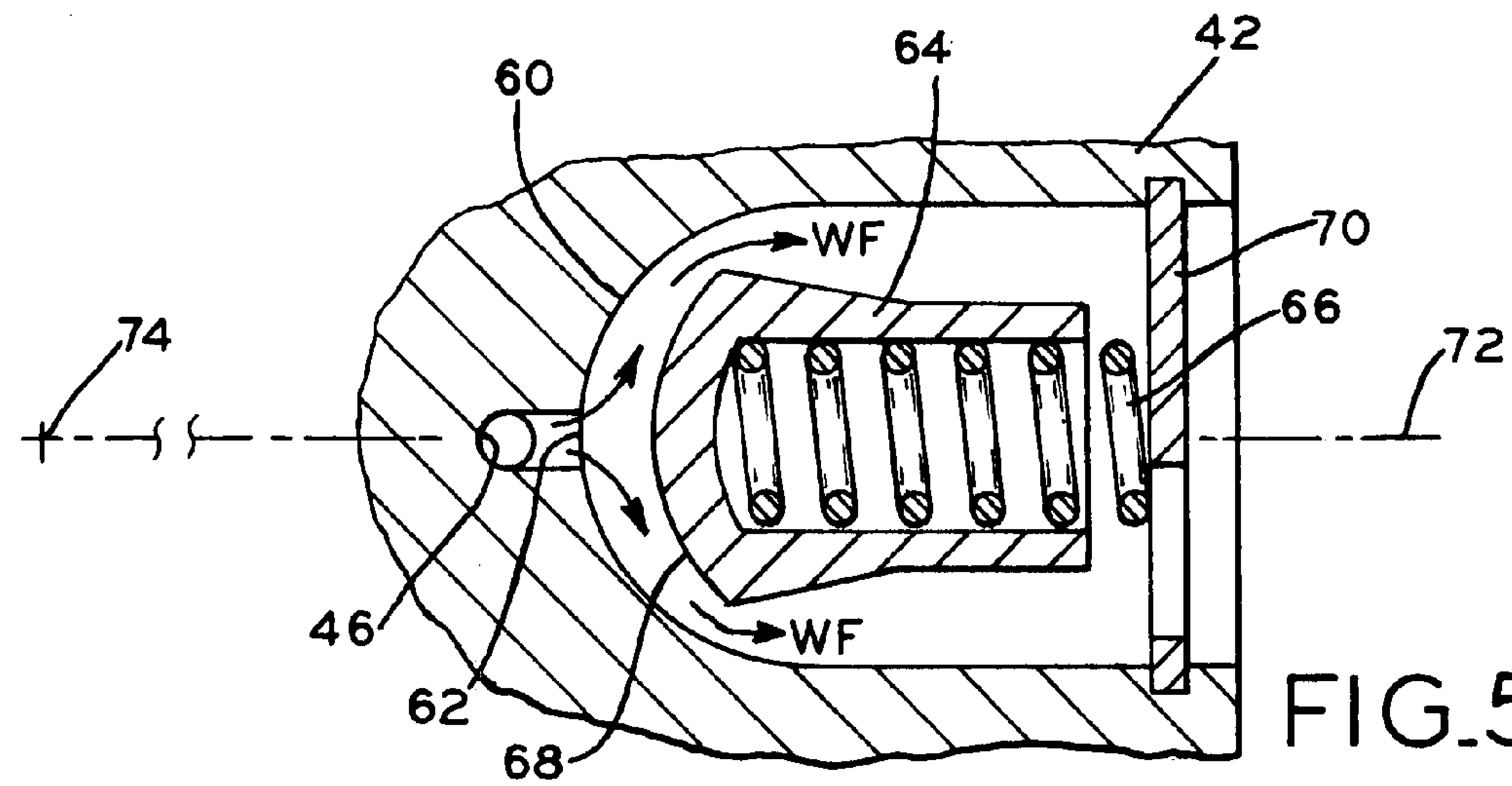

FIG.5B

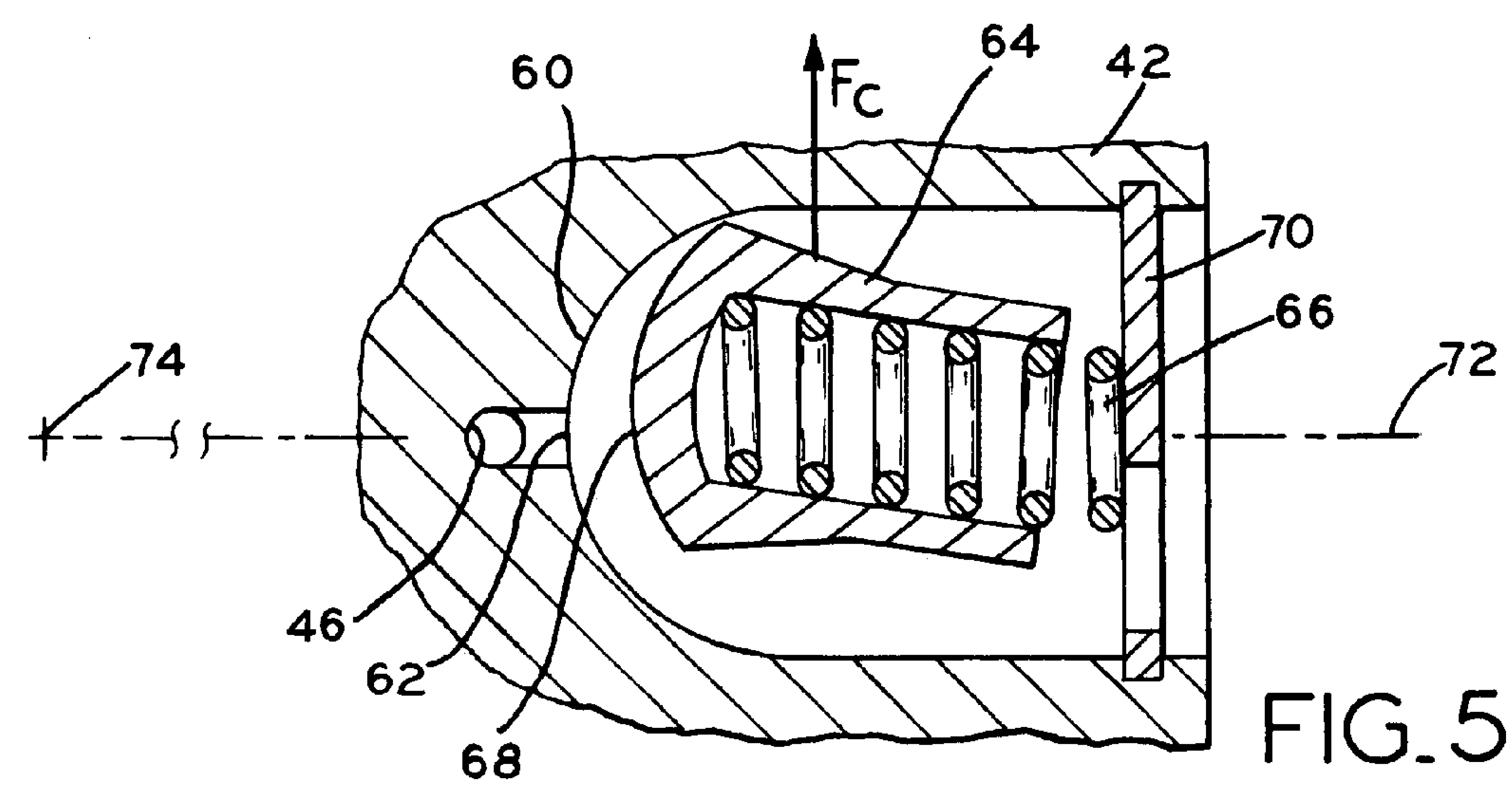

FIG.5C

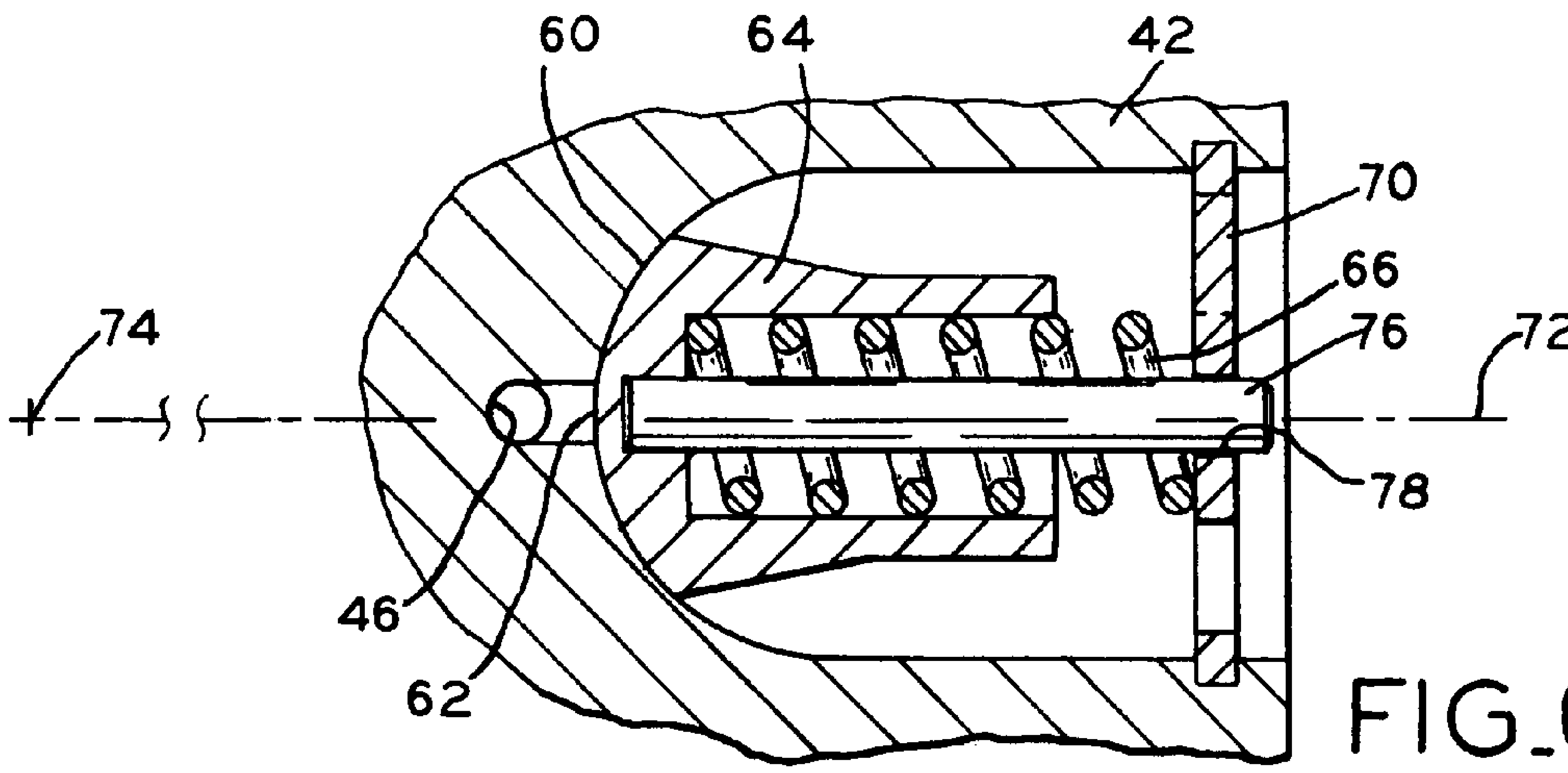

FIG_6A

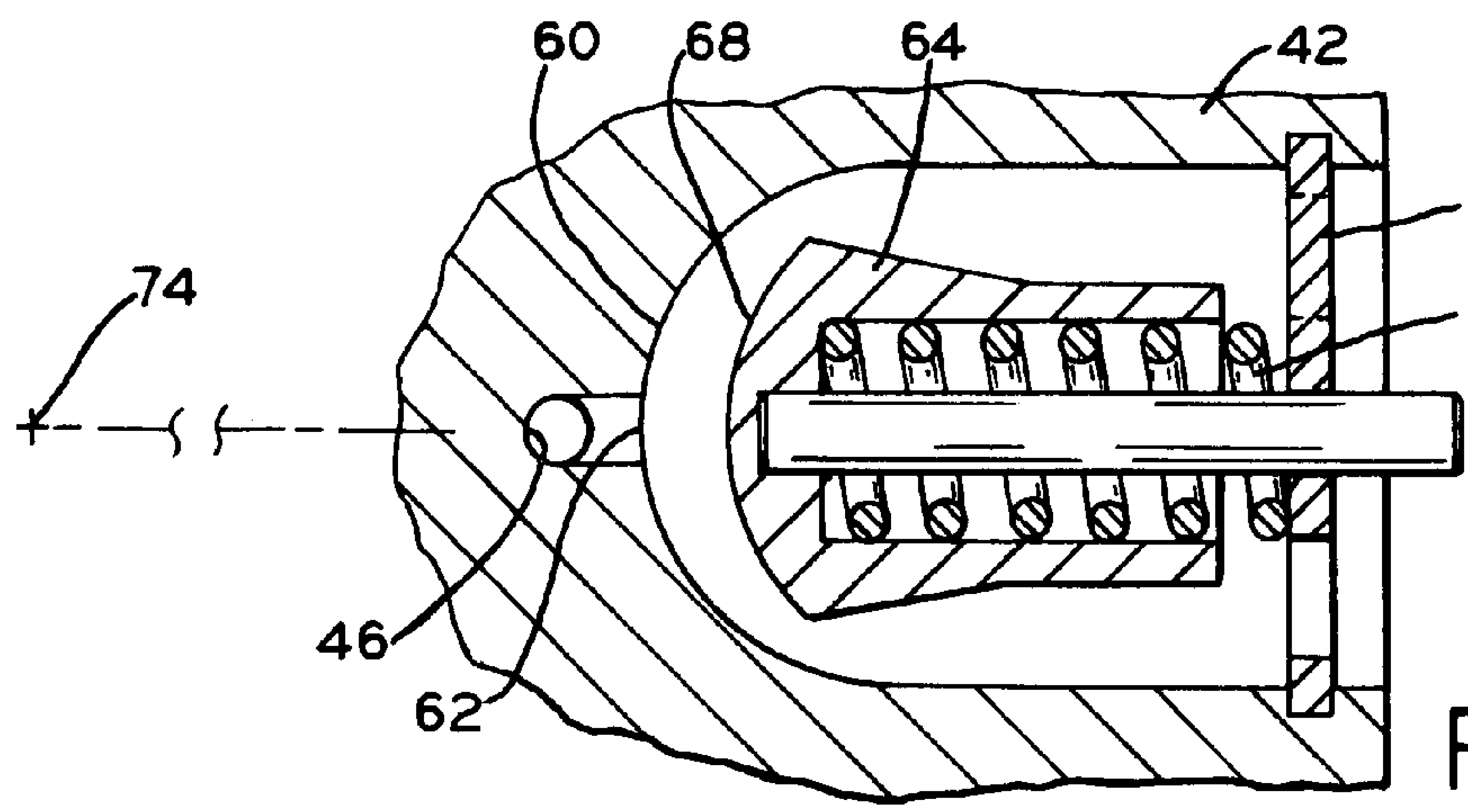

FIG_6B

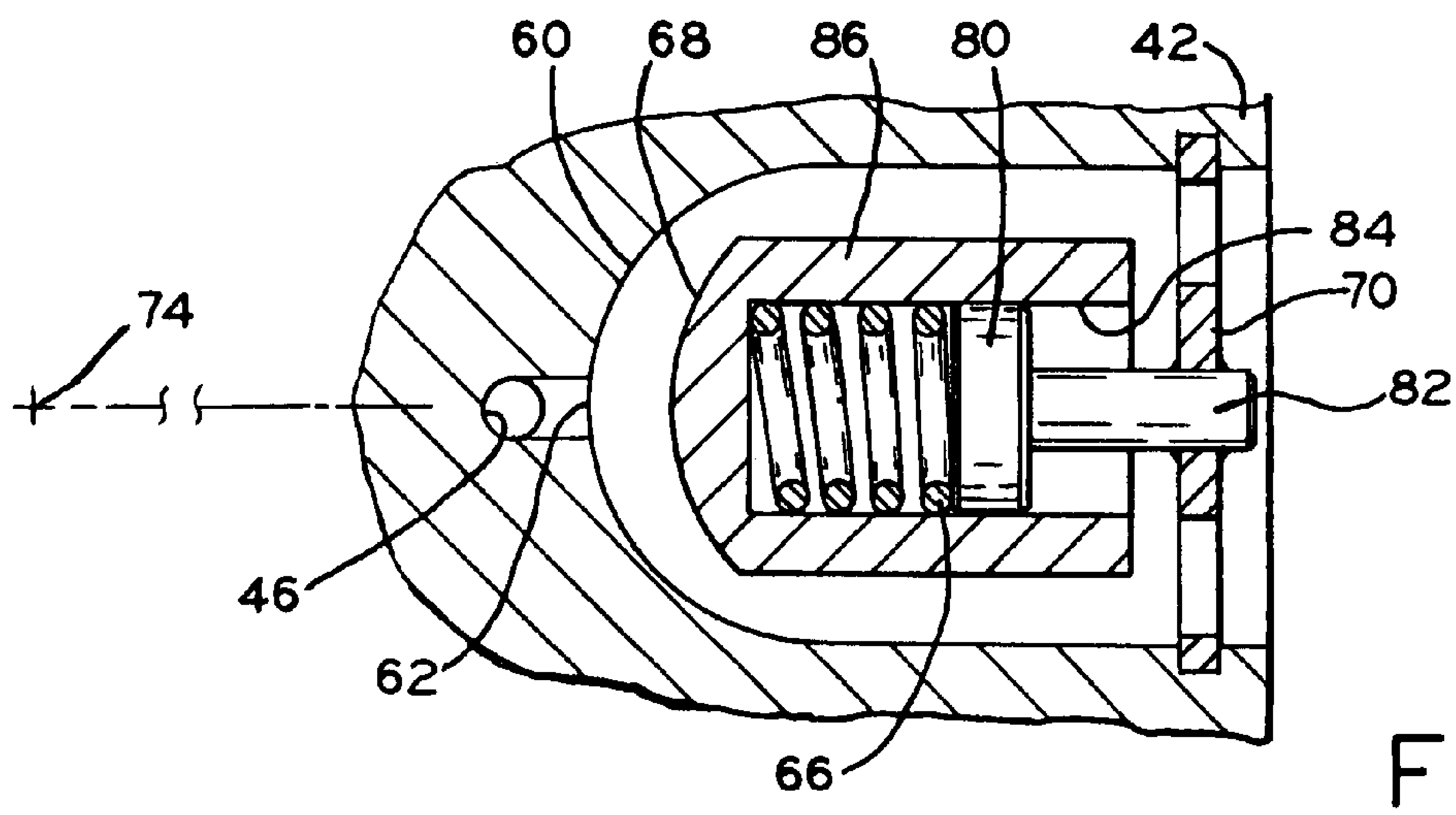

FIG_7

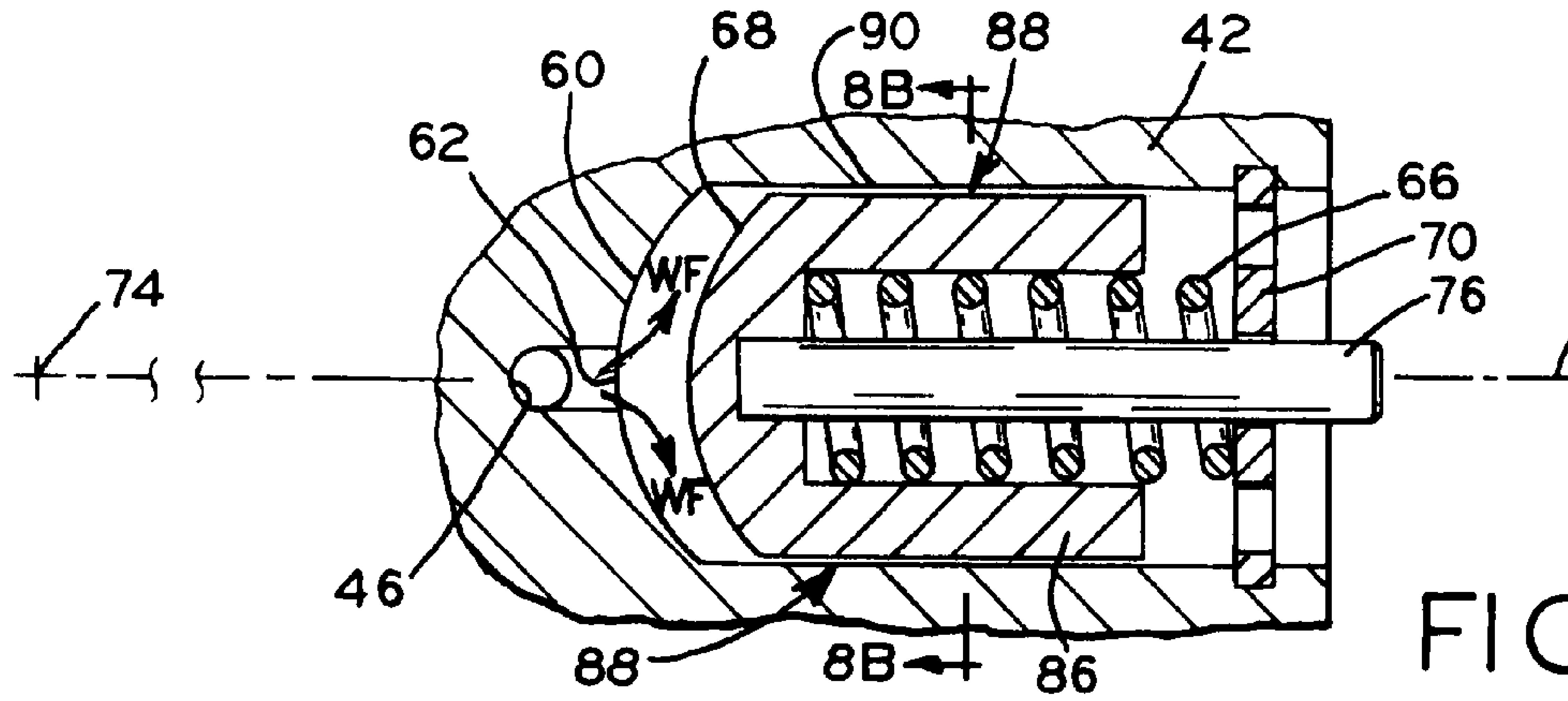

FIG.8A

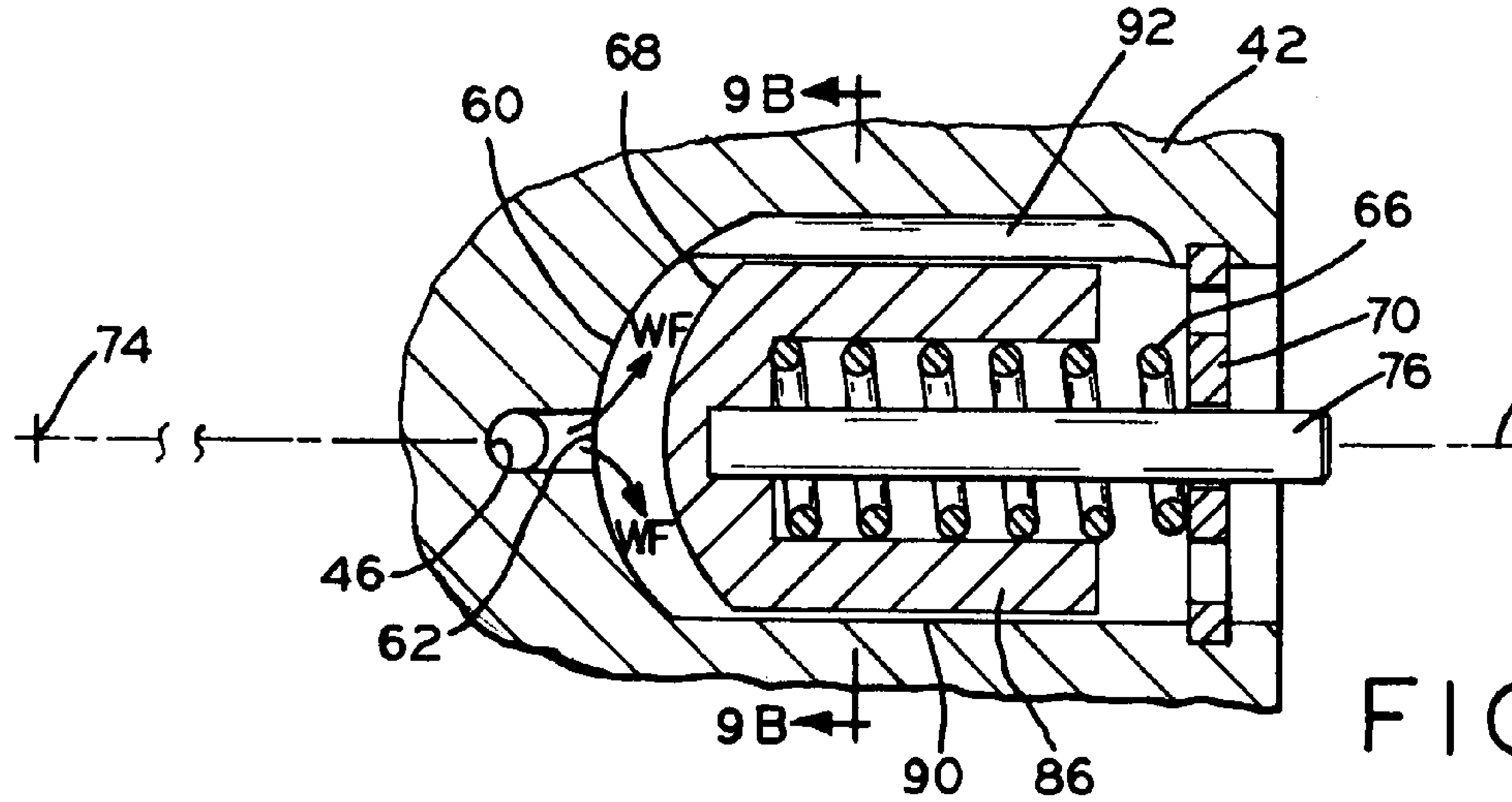

FIG.9A

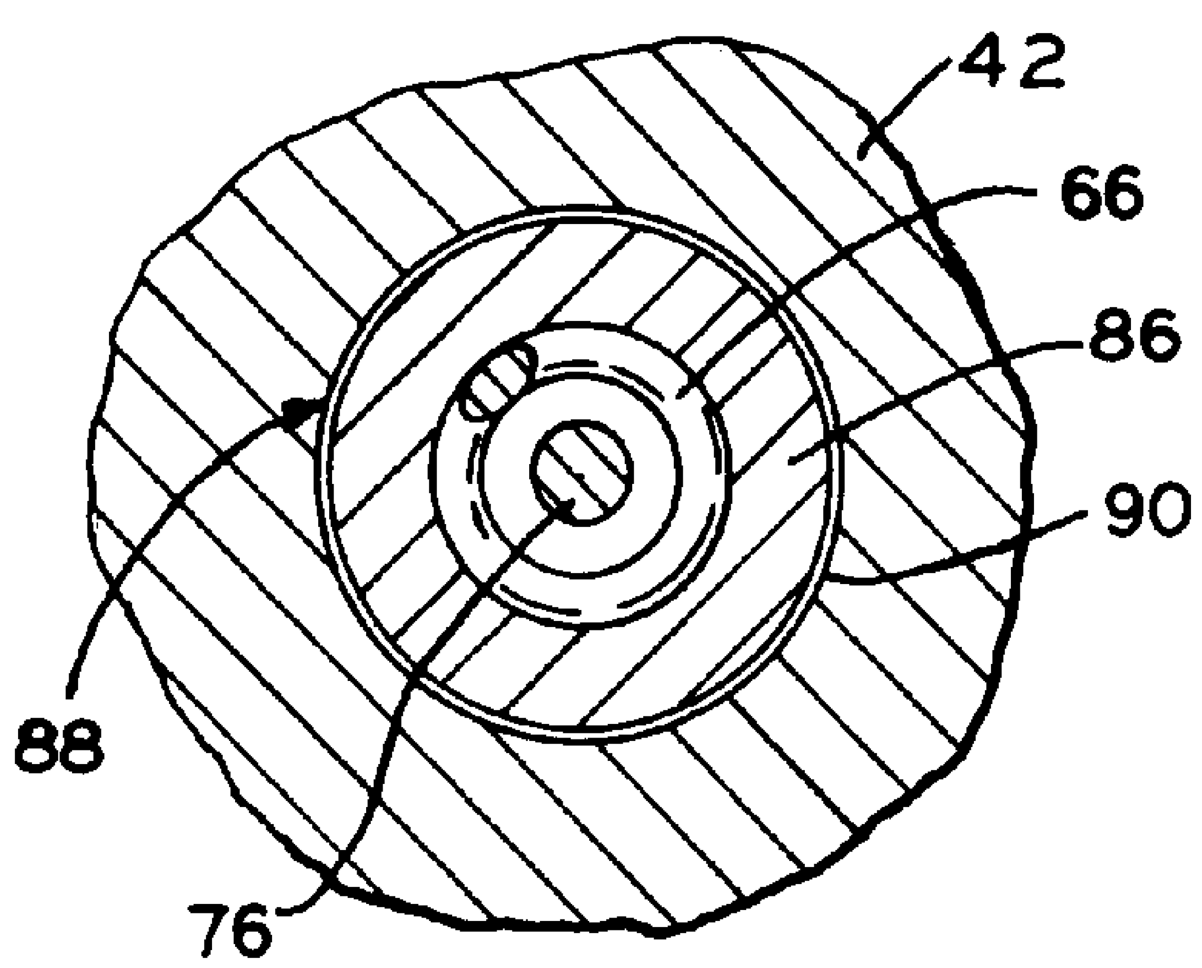

FIG.8B

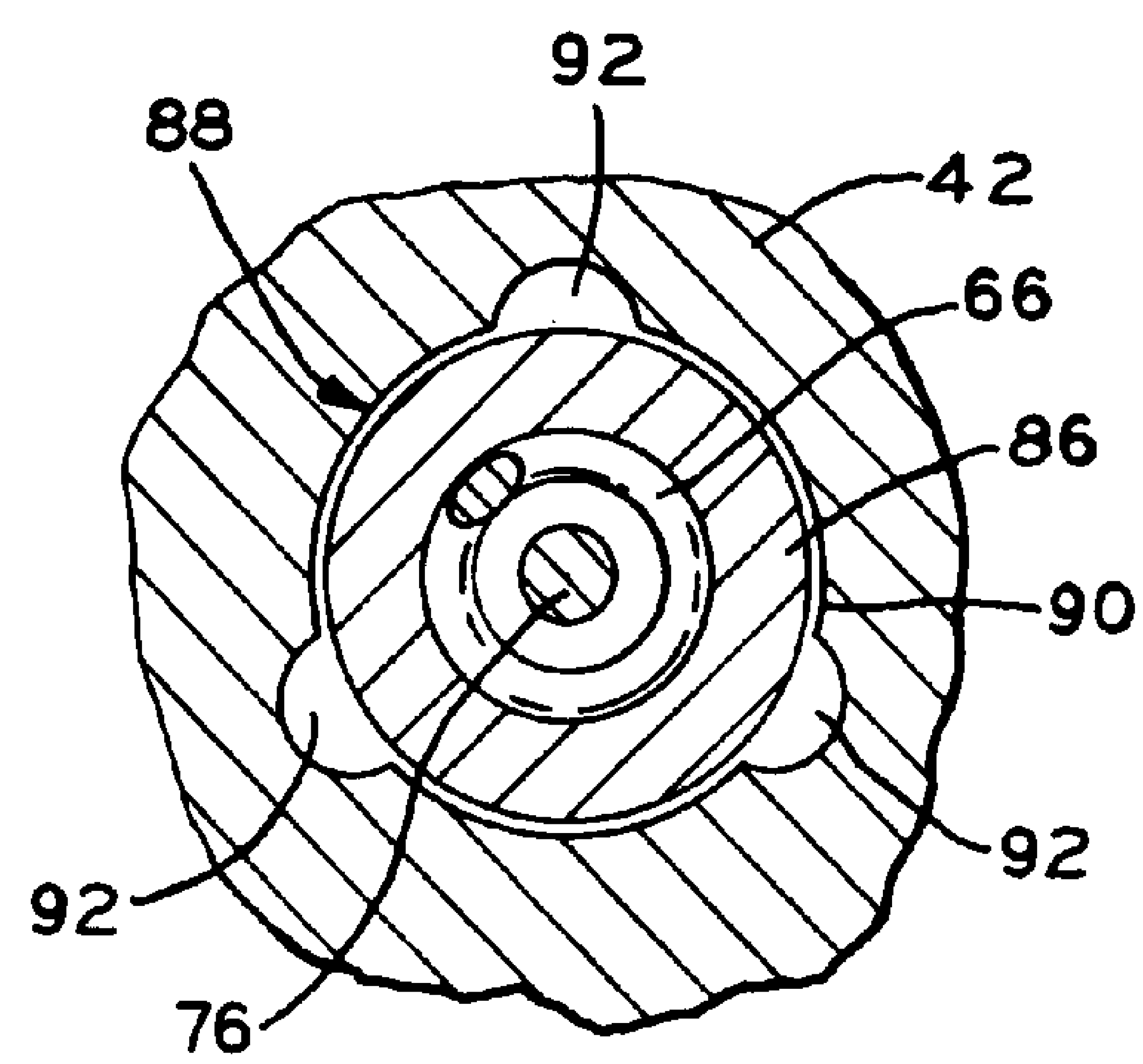

FIG.9B

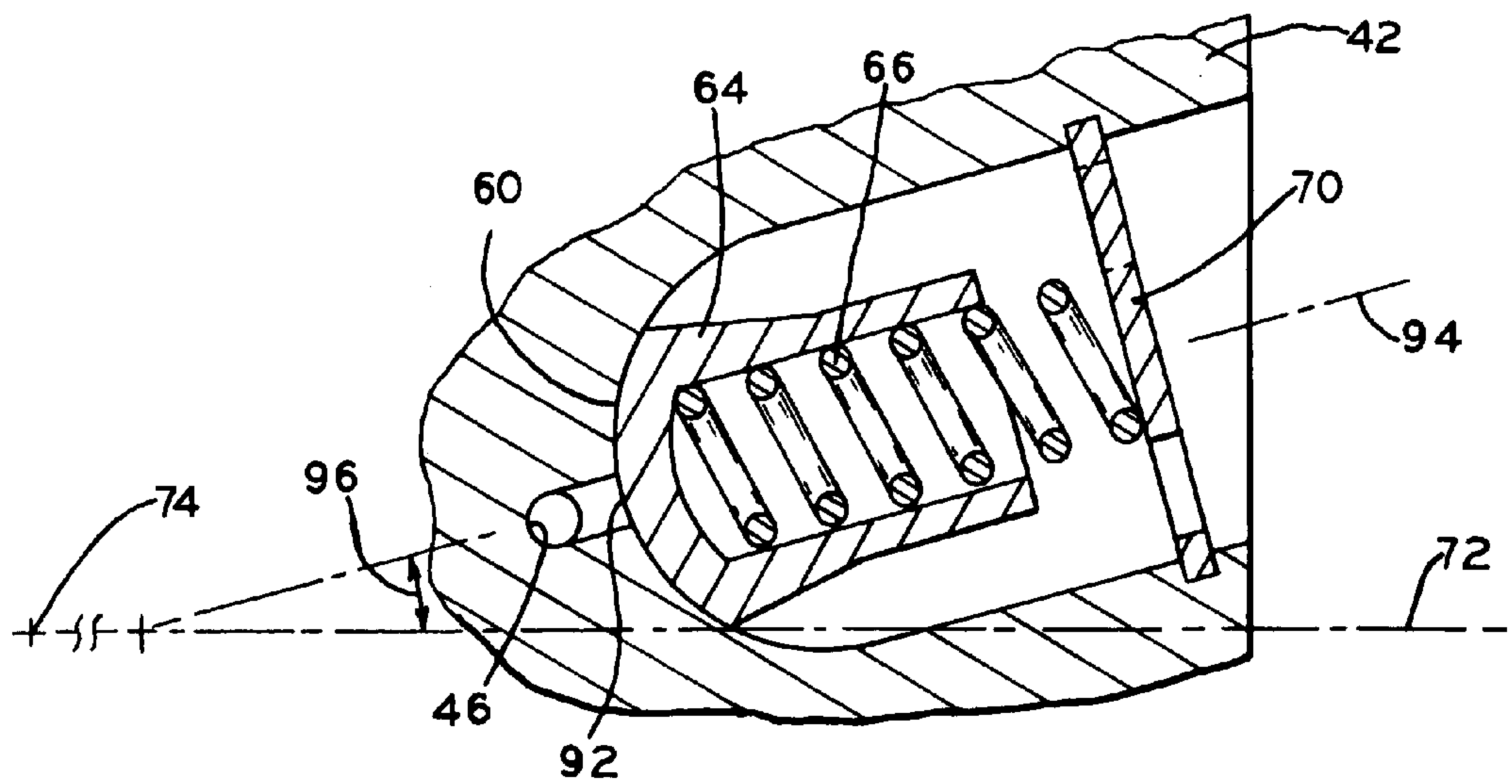

FIG. 10A

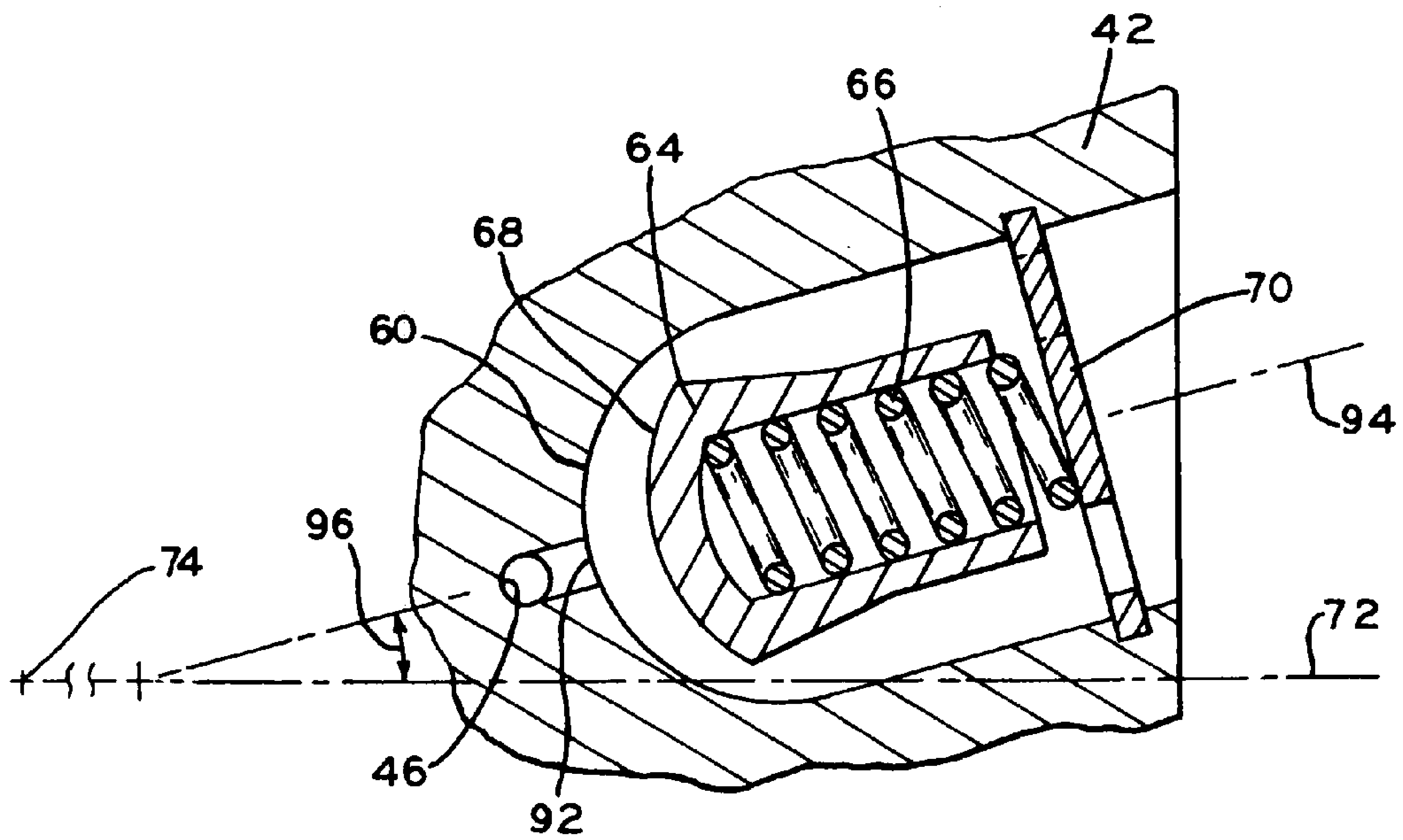

FIG. 10B

ROTARY COMPRESSOR HAVING A DISCHARGE VALVE

CROSS REFERENCE TO RELATED APPLICATION

This application claims the benefit under 35 U.S.C. §119 (e) of U.S. Provisional Patent Application Ser. No. 60/644,653, entitled ROTATING DISCHARGE VALVE, filed on Jan. 18, 2005, the entire disclosure of which is hereby expressly incorporated by reference herein.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present concept relates to rotary compressors. More particularly, the present concept relates to discharge valves for rotary compressors.

2. Description of the Related Art

A typical rotary compressor includes a housing, a stator positioned within the housing, and a rotor driven, i.e., rotated, by the stator, the rotor being mounted to a first end of a crankshaft. The compressor further includes a compression mechanism operably engaged with the opposite end of the crankshaft. The compression mechanism typically includes an eccentric member engaged with the crankshaft that is rotated within a stationary cylinder block to compress a working fluid, or refrigerant, in a compression chamber defined by the eccentric member and the stationary cylinder block. Commonly, a discharge valve is mounted to the stationary cylinder block to release pressurized refrigerant from the compression chamber.

In rotary compressors of the general type disclosed in the present application, unlike the typical compressors described above, the compressor includes a rotatable rotor that surrounds the eccentric member. Such compressors are illustrated and described in co-pending U.S. Published Application No. 2005/0201884 entitled COMPACT ROTARY COMPRESSOR WITH CARBON DIOXIDE AS WORKING FLUID, filed on Mar. 9, 2004. In these compressors, the refrigerant is drawn into a compression chamber defined by the rotor and the eccentric member and is compressed by the relative movement thereof. As the rotating rotor defines the compression chamber, these compressors do not have a stationary cylinder block and the discharge valve is typically mounted on the rotor.

A discharge valve typically includes a valve member that is yieldably positioned against a discharge port of the compression chamber to permit refrigerant to be drawn into the compression chamber and compressed therein. In some embodiments, the valve member, or valve head, is held in this position by a valve spring until sufficient fluid pressure has been generated within the compression chamber. Subsequently, the pressurized fluid lifts the valve head away from the discharge port allowing fluid to be discharged. After a quantity of working fluid has been discharged from the compression chamber, the fluid pressure inside the compression chamber decreases, the pressure force acting on the valve head decreases, and the valve spring repositions the valve head against the discharge port.

The discharge valve, in compressors of the general type disclosed in the present application, may be oriented such that the valve head, when it is displaced, is displaced in a generally radial manner with respect to the axis of rotation of the rotor. As a result of orienting the valve in this manner, the valve head, when the rotor is rotated, is biased radially outwardly towards its open position by an acceleration acting radially on the valve head. To compensate for this acceleration, the stiffness of the valve spring holding the valve head in place can be selected such that valve head remains seated until it is displaced by the fluid in the compression chamber once the fluid has reached a predetermined pressure level.

However, the valve head may also experience an acceleration, and force, tangential to the radial direction discussed above. This tangential force can be created by gas drag, changes in angular velocity of the rotor, or changes in radial position of the valve head. A tangential force created by a change in the radial position of the valve head occurs when the valve head is displaced from the valve seat to release pressurized refrigerant from the compression chamber, and also when the valve head is returned to the valve seat. This tangential force may cause the valve head to displace tangentially with respect to the desired radial path. In effect, the tangential force acting on the valve head may displace the valve head in a non-radial direction or along a curvilinear path, for example. As a result, the valve head may become misaligned with respect to the valve seat, thus allowing semi-compressed working fluid to escape through the compression chamber discharge port prematurely. What is needed is an improvement over the foregoing.

SUMMARY OF THE INVENTION

The present invention includes a valve assembly mounted to a rotor such that the movement of the valve head towards and away from the discharge port in the rotor is substantially linear during the operation of the compressor. To compensate for the tangential forces described above, in one embodiment, the path of the valve head displacement is canted or aligned obliquely with respect to the axis of rotation of the rotor. In this embodiment, the path of the valve head is aligned such that it is substantially co-linear with the resultant force vector applied to the valve head, where the resultant force vector comprises the combined force of the tangential and radial forces applied to the valve head. As a result, in operation, the valve head will lift away from and return to the valve seat along a substantially linear path of displacement, as opposed to being displaced along a substantially curvilinear or undesirable path, as described above. Accordingly, there is less opportunity for the valve head to be misaligned with respect to the valve seat. As discussed above, an improperly seated valve head may allow working fluid to escape the compression chamber insufficiently pressurized, thus rendering the compressor inoperable or inefficient. Further, a misaligned valve head may also cause the valve head to impact the valve seat with additional force and thus cause undesirable noise and/or premature wear of the valve head.

In other embodiments, an external guide may be provided to guide the valve head and thus limit the valve head's tangential movement. Further, a guide can be positioned internal to the valve head to likewise prevent tangential movement of the valve head.

BRIEF DESCRIPTION OF THE DRAWINGS

The above-mentioned and other features and advantages of this invention, and the manner of attaining them, will become more apparent and the invention itself will be better understood by reference to the following descriptions of embodiments of the invention taken. in conjunction with the accompanying drawings, wherein:

FIG. **1** is an elevational cross-sectional view of a rotary compressor in accordance with an embodiment of the present invention;

FIG. **1**A is a detail view of the discharge valve assembly of the rotary compressor of FIG. **1**;

FIG. **2** is an elevational cross-sectional view of the rotary compressor of FIG. **1**;

FIG. **3** is a cross-sectional view of the rotary compressor of FIG. **1** taken along line **3-3** in FIG. **2** illustrating a compression mechanism in a first position;

FIG. **4** is a cross-sectional view of the rotary compressor of FIG. **1** similar to FIG. **3** illustrating the compressor mechanism in a second position;

FIG. **5**A is a cross-sectional view of the discharge valve assembly of FIG. **1**A taken along line **5**A-**5**A in FIG. **1**A;

FIG. **5**B is a view of the valve head of the discharge valve assembly of FIG. **5**A displaced radially from the valve seat;

FIG. **5**C is a view of the valve head of the discharge valve assembly of FIG. **5**A displaced radially and tangentially from the valve seat;

FIG. **6**A is a cross-sectional view of a discharge valve assembly having a valve stem affixed to a valve head in accordance with an alternative embodiment of the present invention;

FIG. **6**B is a view of the valve head of the discharge valve assembly of FIG. **6**A displaced radially from the valve seat;

FIG. **7** is a cross-sectional view of a discharge valve assembly having a guide internal to the valve head in accordance with an alternative embodiment of the present invention;

FIG. **8**A is a cross-sectional view of a discharge valve assembly having a guide external to the valve head in accordance with an alternative embodiment of the present invention;

FIG. **8**B is a plan view of the discharge valve assembly of FIG. **8**A;

FIG. **9**A is a cross-sectional view of a discharge valve assembly having a guide external to the valve head and vent passages to facilitate fluid flow between the valve head and external guide in accordance with an alternative embodiment of the present invention;

FIG. **9**B is a plan view of the discharge valve assembly of FIG. **9**A;

FIG. **10**A is a cross-sectional view of a discharge valve assembly having an axis of displacement oblique to a radial axis perpendicular to the axis of rotation of a rotor in accordance with an alternative embodiment of the present invention; and

FIG. **10**B is a view of the valve head of the discharge valve assembly of FIG. **10**A displaced from the valve seat along the oblique axis.

Corresponding reference characters indicate corresponding parts throughout the several views. The exemplifications set out herein illustrate preferred embodiments of the invention, and such exemplifications are not to be construed as limiting the scope of the invention in any manner.

DETAILED DESCRIPTION OF THE INVENTION

Referring to FIGS. **1-4**, an exemplary rotary compressor **10** includes a hermetically sealed housing **12** including base **14**, annular side wall **15** and top wall **16**. Base **14** is hermetically sealed to wall **15** by welding, brazing, or the like at location **17**. Similarly, side wall **15** is hermetically sealed to top wall **16** by welding, brazing, or the like at location **18**. Compressor **10** includes electric motor **24** having stator **26** and rotor **28** which defines a portion of compression mechanism **30**. Compression mechanism **30** compresses a refrigerant, such as carbon dioxide, for example, from a low pressure to a higher pressure for use in a refrigeration system, for example. Stator **26** is rigidly mounted within housing **12** and circumscribes rotor **28**. Extending through rotor **28** is stationary shaft **34** which is, in this embodiment, integrally formed with top wall **16**. During operation, stator **26** generates a rotating electromagnetic field to rotationally drive rotor **28**, having permanent magnets **29** mounted in recesses **31**, about an axis defined by shaft **34**. Compressor **10** further includes oil in oil sump **13** which accumulates in oil sump **13** after precipitating from the refrigerant flowing through the compressor. Shaft **34** includes oil passages **11** which direct a flow of oil from the refrigerant to bearing surfaces between the relatively moving components of the compressor. Other exemplary rotary compressors are illustrated and described in U.S. Published Application No. 2005/0201884 entitled COMPACT ROTARY COMPRESSOR WITH CARBON DIOXIDE AS WORKING FLUID, filed on Mar. 9, 2004, the entire disclosure of which is hereby expressly incorporated by reference herein.

Rotor **28** includes annular section **21** and end plates **42** and **44** and holes **25** for receiving bolts **27** which fasten annular section **21** and end plates **42** and **44** together. As discussed below, rotor **28** also defines internal compression chamber **33**. Referring to FIGS. **1-4**, an eccentric portion **38** is integrally formed on shaft **34** and is located within the compression chamber defined by rotor **28**. Compression mechanism **30** further includes roller **36** which is rotatably mounted on eccentric **38**. Vane **40** extends radially inwardly within the compression chamber to engage roller **36**. As illustrated in FIGS. **3** and **4**, vane **40** has a first end positioned within slot **41** in roller **36** and a second end fixed within slot **39** of rotor **28**. Vane **40**, together with roller **36**, divides the compression chamber into variable-volume, crescent-shaped suction and compression pockets. As vane **40** is mutually engaged with roller **36** and rotor **28**, roller **36** is rotationally driven by rotor **28** through vane **40**. However, the axis of rotation of roller **36** is offset, or eccentric, with respect to the axis of rotation of rotor **28**. As a result, rotor **28** drives roller **36** in an orbiting motion about eccentric portion **38**. This orbiting motion draws in and compresses pockets of refrigerant between rotor **28** and roller **36**. To account for the eccentric movement of roller **36** with respect to rotor **28**, vane **40** can slide within slot **41** of roller **36**. In addition, as illustrated in FIGS. **3** and **4**, vane **40** can assume a range of angular orientations with respect to roller **36**. More particularly, roller **36** includes bushing **43**, which defines slot **41**, which is free to pivot within recess **45**, thereby allowing vane **40**, which is positioned in slot **41**, to rotate relative to roller **36**. Bushing **36** further includes elongate aperture **33** for receiving pin **35**. The ends of pin **35** are fixed within rotor **28** and define an axis about which bushing **36** and vane **40** may rotate.

During operation, in the present embodiment, low pressure refrigerant is drawn into the compression chamber through longitudinal passage **54** in shaft **34**. Once the refrigerant gas is compressed to a higher pressure within the compression chamber, the compressed refrigerant is discharged through a discharge passage **46** (FIG. **1**) and a discharge valve, such as discharge valve **48**, for example, into an interior chamber **50** of housing **12**. Thereafter, the compressed refrigerant exits interior chamber **50** through outlet **52**. Compressor **10**, in the present embodiment, is a high side compressor, however, the present invention is not so limited. Further, in the present embodiment, the compression chamber is located internal to the rotor. In other embodiments, the rotor may be on the outside of the rotor.

In the embodiment illustrated in FIGS. **1-3**, discharge valve **48** includes valve seat **60** surrounding discharge port **62**. Discharge port **62** is in fluid communication with the compression chamber via discharge passage **46**. Discharge valve **48** includes valve member **64** which has a substantially spherical sealing surface **68** biased into engagement with valve seat **60** by spring **66** to seal discharge port **62**. As illustrated in FIG. **1**A, spring **66** is compressed between valve member **64** and valve support **70**. Valve spring **66** may be a conventional coil spring and may be produced from conventional materials including brass or steel. Although the springs discussed herein are substantially linear springs, which are common in poppet valves, other springs, including non-linear and torsion springs, e.g., may be used in other embodiments.

Interior **65** of valve member **64** may be concave or may possess other configurations sufficient to prevent valve member **64** and valve spring **66** from separating from one another. In one embodiment, a retaining ring (not shown) can be used to secure spring **66** within valve member **64**. Referring to FIGS. **5**A-**5**C, discharge valve **48** is mounted to the rotor of the compressor such that the axis of spring **66**, and the desired axis of displacement of valve member **64**, i.e., axis **72**, is perpendicular to axis of rotation **74**. Axes **72** and **74** define a plane proximate valve member **64** and which is coplanar with the plane of the drawing sheet of FIG. **1** and perpendicular to the drawing sheet of FIGS. **5**A-**5**C.

During the operation of the compressor, the pressure level of the refrigerant, or working fluid, in the compression chamber increases as the rotor is turned by the stator. The pressurized fluid applies a force to valve member **64** tending to lift valve member **64** away from valve seat **60**. However, valve member **64** will remain seated against valve seat **60** until the pressure force applied to valve member **64** is sufficient to overcome the spring force biasing valve member **64** against valve seat **60**. Once valve member **64** has been lifted away from valve seat **60**, a quantity of working fluid, illustrated by arrows WF in FIG. **5**B, may escape from the compression chamber. As the working fluid escapes, the pressure level of the working fluid in the compression chamber decreases. As the pressure decreases, the force applied to valve member **64** by the working fluid will be overcome by the spring force of spring **66** such that valve member **64** is re-biased against valve seat **60** by spring **66**.

Referring to FIG. **5**B, when valve member **64** is displaced, the desired direction of displacement is along a generally radial path, such as displacement axis **72**, which is perpendicular to the rotor axis of rotation **74**. However, in operation, as valve member **64** is rotated about axis **74**, valve member **64** may experience an inertial tangential acceleration, and force, normal to displacement axis **72** when its radial position with respect to axis **74** changes. This tangential force, labeled Fc in FIG. **5**C, may displace valve member **64** normally to axis **72** causing valve spring **66** to flex. This tangential displacement may prevent valve member **64** from being properly reseated against valve seat **60**. If valve member **64** is not reseated properly against valve seat **60**, working fluid may continue to escape through exhaust port **62** and, accordingly, the compressor may not be able to adequately pressurize the fluid.

The inertial tangential force discussed above occurs when valve member **64** is displaced radially as it is seated and unseated from valve seat **60**, for example. However, the inertial tangential force may not occur when the radial position of valve member **64** is stationary, such as when valve member **64** is seated against valve seat **60**, or when the valve member **64** is held in a constant position displaced away from valve seat **60**. In order to prevent valve member **64** from being displaced tangentially by this tangential force, the tangential force must be compensated for while the radial position of valve member **64** is changing.

In one exemplary embodiment, as illustrated in FIGS. **6**A and **6**B, the tangential force acting on valve member **64** is compensated for by affixing, or rigindly connecting, valve stem **76** to valve member **64**. Valve stem **76** passes though valve stem aperture **78** in valve support **70**, where valve stem **76**, and valve member **64** affixed thereto, are relatively free to translate along radial axis **72**. Valve stem **76** is substantially constrained from displaing in a direction tangential to axis **72** by the interaction of, i.e., the closely interfitting relationship between, valve stem **76** and valve stem aperture **78**. Thus, as illustrated in FIG. **6**B, as valve member **64** is displaced toward or away from valve seat **60**, valve member **64**. will move substantially along axis **72**.

In another embodiment, as illustrated in FIG. **7**, valve assembly **48** may include internal guide **80** to limit the displacement of valve member **86**. In this embodiment, internal guide **80** is substantially rigid and is affixed to or integral with valve support **82**. Internal guide **80** is closely received by interior **84** of valve member **86**. Although very little.gap exists between valve member **86** and interior **84**, sufficient clearance exists to permit relative motion therebetween. In use, internal guide **80** limits the tangential displacement of valve member **86** when a tangential force is applied to valve member **86**, as described above.

In another exemplary embodiment, as illustrated in FIGS. **8**A and **8**B, the tangential force may be compensated for by an external guide. As illustrated in FIGS. **8**A and **8**B, gap **88** between surrounding guide wall **90** and valve member **86** is large enough to permit relative radial motion between valve member **86** and guide wall **90**, yet small enough to prevent substantial translation of valve member **86** tangential to axis **72**. After a small amount of translation, valve member **86** will bear against guide wall **90** preventing further translation.

In the embodiment illustrated in FIGS. **8**A and **8**B, gap **88** may be too small to permit working fluid to pass between valve member **86** and guide wall **90**. Thus, an alternate path may be provided for the working fluid to flow through. Referring to FIGS. **9**A and **9**B, vents **92** may be provided around the perimeter of guide wall **90** to permit fluid to pass between valve member **86** and guide wall **90**. In the exemplary embodiment illustrated in FIGS. **9**A and **9**B, three vents **92** are provided. Any number of vents **92** may be provided as long as there remains sufficient bearing surface between guide wall **90** and valve member **86** to prevent valve member **86** from substantially translating in the tangential direction. In other embodiments, apertures (not illustrated) may be provided in the side of valve member **86** to facilitate the flow of working fluid.

In other embodiments, as illustrated in FIGS. **10**A and **10**B, valve member **64** may be displaced along a substantially linear path, such as axis **94**, without the assistence of a valve stem or guides. Referring to the illustrated embodiment in FIGS. **10**A and **10**B, axis of displacement **94**, which is also the axis of valve spring **66**, is oriented at an acute angle with respect to the plane defined by axis of rotation **74** and radial axis **72** such that it is substantially co-linear with the resultant force acting on valve member **64**, as discussed in further detail below. In other words, axis **94** lies in a plane perpendicular to the axis of rotation **74** and is canted or aligned obliquely with respect to the axis of rotation **74** so that it does not intersect the axis of rotation **74**. As axis **94** and the resultant force are substantially co-linear, valve member **64** is displaced along a substantially straight path.

The resultant force acting on valve member **64** represents the combined force vector acting on valve member **64** which includes the inertial tangential force created from the radial displacement of valve member **64**, the centrifugal radial force acting on valve member **64** due to the rotation of the rotor, the pressure force applied on valve member **64** by the working fluid, and the gravitational weight of the valve member **64**, among others. Other forces, including gas drag and forces resulting from changes in angular velocity, i.e., rotation speed of the rotor, may also act on the valve member and may also be included in determining the resultant force.

The resultant force is counteracted by spring **66** which resists the movement of valve member **64**. The stiffness of spring **66** is selected such that valve member **64** remains seated against valve seat **60** when the pressure of the working fluid in the chamber is below a pre-determined pressure level. However, the stiffness of spring **66** is also selected such that valve member **64** can lift away from valve seat **60** when the pressure level of the working fluid exceeds the pre-determined pressure level.

The angle between displacement axis **94** and the plane defined by axis of rotation **74** and radial axis **72**, i.e., angle **96**, for any given embodiment will depend upon the magnitude and direction of the forces discussed above. To calculate an appropriate angle **96**, the accelerations and forces acting on valve member **64** are summed in three relative directions and are used to solve for the appropriate angle **96**. Once angle **96** has been determined, in the present embodiment, valve assembly **48** is oriented such that the axis of coil spring **66** is substantially co-linear with the direction of the resultant force. Stated in another way, valve assembly **48** is canted with respect to the plane defined by axis of rotation **74** and axis **72**. In this context, oblique means that axis **94** is neither perpendicular to nor parallel with the plane defined by axis of rotation **74** and axis **72**.

Slight variations from the calculated angle **96** may allow valve member **64** to be displaced slightly tangential to axis **96** or displaced along a somewhat curvilinear path. However, these slight variations will not necessarily cause valve member **64** to become grossly, or inoperatively, misaligned with valve seat **60**. To account for misalignment between the valve head and valve seat, valve seat **60** or sealing surface **68** of valve member **64** may be beveled, or radiused, e.g., such that valve member **64** is guided into valve seat **60**.

As noted above, the inertial tangential force acting on valve member **64**, owing to changes in radial position of valve member **64**, only occurs when the distance between valve member **64** and the axis of rotation **74** is changing. At all other times, when valve member **64** is not moving radially with respect to the axis of rotation, this inertial tangential force is not acting on valve member **64**. In view of this, even though an optimum angle **96** can be. calculated when the inertial tangential force is being applied, consideration for other orientations where the inertial tangential force is not present should be accounted for during the selection of angle **96**. In particular, during the above-discussed conditions where the inertial tangential force is not acting on valve member **64**, other tangential forces may be acting on valve member **64** owing to, as discussed above, gas drag and changes in rotor speed.

In most circumstances, as the valve moves radially outwardly, the valve head will "lag" behind, or move in the opposite direction of the rotation due to the tangential force discussed above. However, the valve head will "lead", or move in the direction of rotation, when it moves radially inwardly. In other words, the direction of the tangential force acting on the valve head will depend on whether the valve head is being lifted away from or towards the valve seat. Thus, a combination of the improvements discussed above may be necessary to compensate for this phenomena. For example, the valve assembly may be oriented or inclined such that when the valve head is moving outwardly, the valve head moves along axis **94** in response to the resultant force. However, an external or internal guide, as discussed above, may be necessary to oppose the oppositely directed tangential force that occurs when the valve is moving towards the valve seat.

In some embodiments, the angle of valve assembly **48** with respect to the rotor may be adjustable. In these embodiments, angle **96** may be selected from a range of values to align the path of displacement of valve member **64** with the resultant force acting on the valve head. Valve assembly **48** may be held in this selected position by any suitable means, including a ratcheting device, set screw or another suitable fastener. In one embodiment, angle **96** is oriented with respect to the plane defined by axis of rotation **74** and axis **72** at an angle greater than zero degrees but less than or equal to 15 degrees. However, other angles may be preferred in other embodiments. In other embodiments, the axis of displacement may be oriented in any direction that would allow that valve head to be properly seated and unseated from the valve seat.

Orienting the valve assembly in the manners discussed above may provide the added benefit of reducing pressure losses. More particularly, it may be possible to direct the flow of the working fluid exiting the discharge valve away from obstructions which could restrict the flow of the fluid and thus reduce pressure losses. A further advantage of the present embodiment includes aligning contact surface **68** of valve member **64** with valve seat **60** such that the lubricating oil contained in the working fluid exiting the discharge valve is deposited in a substantially even layer on surface **68**. A uniform oil film thickness on the valve head is important to control the impact stress distribution across surface **68** as well as reduce the the noise generated when valve head **64** impacts valve seat **60**.

While this invention has been described as having a preferred design, the present invention can be further modified within the spirit and scope of this disclosure. This application is therefore intended to cover any variations, uses, or adaptations of the invention using its general principles. Further, this application is intended to cover such departures from the present disclosure as come within known or customary practice in the art to which this invention pertains and which fall within the limits of the appended claims.

What is claimed is:

1. A rotary compressor, comprising:

a housing;

a motor;

a roller and a vane engaged with said roller;

a rotor positioned within said housing, said rotor driven by said motor and rotatable about an axis of rotation, said rotor engaging said roller and vane to thereby define a compression chamber, said rotor having a discharge port and a valve seat disposed around said discharge port, said discharge port in fluid communication with said compression chamber; and

a valve mounted on said rotor, said valve comprising:

a valve head yieldably positioned against said valve seat; and

a valve spring, said valve spring yieldably positioning said valve head against said valve seat, said valve spring defining a first axis, said valve head movable along said first axis,

wherein said valve head is displaceable from said valve seat to allow compressed fluid within said compression chamber to exit said compression chamber through said discharge port, and

wherein said axis of rotation and a radial axis perpendicular to said axis of rotation define a plane, and wherein said valve spring is oriented such that said first axis is oblique with respect to said plane such that said first axis does not intersect said axis of rotation.

2. The compressor of claim **1**, wherein said first axis intersects said plane at an angle greater than zero degrees but less than or equal to 15 degrees.

3. A rotary compressor, comprising:

a housing;

a motor;

a roller and a vane engaged with said roller;

a rotor positioned within said housing, said rotor driven by said motor and rotatable about an axis of rotation, said rotor engaging said roller and vane to thereby define a compression chamber, said rotor having a discharge port in fluid communication with said compression chamber;

a valve comprising:

a valve head positioned to cover said discharge port; and

a valve spring yieldably positioning said valve head over said discharge port; and

means for aligning the movement of said valve head with respect to said valve seat in a direction neither parallel to nor perpendicular and intersecting with said axis of rotation, whereby said valve head is repositioned against said valve seat upon closing.

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